

Dr. Terence L. Kubar

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EDUCATION

Ph.D. Atmospheric Sciences	University of Washington	2008
B.A. Meteorology (Minor: Applied Math)	San Jose State University	2003

RELEVANT EXPERIENCE

Dr. Kubar is an Assistant Research Scientist at the Joint Institute for Regional Earth System Science and Engineering at UCLA, working remotely at Jet Propulsion Laboratory in the Aerosols and Clouds Group. His research interests include satellite remote sensing of clouds, precipitation, and convection using a plethora of multi-sensor A-Train datasets, and he has published several papers on the vertical structure of tropical clouds, radiative forcing of tropical high clouds, high-topped cloud and rain rate relationships, as well as controlling factors of deep convective clouds. Dr. Kubar has also assessed variations of low cloud properties from MODIS and ERA-Interim reanalysis data and their dependence on large-scale dynamics and a new measure of stability to assess the stratocumulus-to-cumulus transition, and to evaluate two versions of the NCAR Community Atmosphere Model (CAM5), both the base model and one which has implemented a new subgrid low cloud parameterization (CAM-CLUBB). His conditional probability distribution function method is now being implemented into a climate model evaluation web tool in association with the “Climate Model Diagnostic Analyzer” project.

Dr. Kubar has also used satellite and reanalysis datasets to examine synoptic to subseasonal variations of low clouds and vertical profiles of moist static energy, vertical velocity, temperature, and relative humidity over the southeast Pacific, and has identified strong coherence between boundary layer cloud top height and either potential temperature or relative humidity at or just above cloud top at submonthly timescales. Anomalous cloud fraction, while predicted with skill by measures of stability or moisture, exhibits more noise than cloud top height, and at least some of the variation of cloud fraction can be explained by the shorter periodicity of vertical velocity. The relationship between increased subsidence and higher low cloud top heights, while at glance not expected, can be explained by the baroclinic structure of the lower troposphere in the southeast Pacific.

He is the PI of a three-year NASA ROSES project selected in 2014, entitled: “Radiative and Large-Scale Forcing of Tropical Clouds and Their Controls on High SST Environments Using Multi-Sensor Aqua and ECMWF-Reanalysis Datasets,” and has recently been extensively examining the intimate relationships between SST hot spots, air-sea fluxes, large-scale vertical and horizontal winds, deep convection, and precipitation using satellite observations and reanalysis data on synoptic to interannual timescales in near-equatorial regions characterized by the highest SSTs on the globe, and over which climate sensitivity can be parsed. This project has firmly established the meteorological setup before, during, and after SST hot spots; during the growth stage of hot spots, the normally persistent easterly winds that dominate the region just south of the equator and just west of the dateline slacken during the growth period of hot spots. Ocean temperatures then reach their maximum under the lightest wind conditions, and this, coupled with preceding stronger southeasterlies to the south, help establish an anomalously strong temperature gradient across the domain. This strong gradient establishes converging low-level airflow towards the highest SSTs, with a switch to westerly winds bringing enhanced unstable air into the region. This, coupled with anomalously strong low-level convergence, create large-scale ascent, organized deep convection, and maximum precipitation for a sustained period of at least 15-30 days following peak SST.

PROFESSIONAL EXPERIENCE

- 2014 – present:** Assistant Research Scientist –
Joint Institute for Regional Earth System Science and Engineering at UCLA
(affiliated with Aerosols and Clouds Group at Jet Propulsion Laboratory, Pasadena, CA)
- 2011 – 2014:** Research Scientist in Department of Atmospheric Science at Colorado State University
(affiliated with Climate Physics Group at Jet Propulsion Laboratory, Pasadena, CA)
- 2010 – 2011:** Caltech Postdoctoral Research Scholar – Climate Physics Research Group
Earth Science Division – Jet Propulsion Laboratory, Pasadena, CA
- 2008 – 2010:** Postdoctoral Research Associated/NASA Fellow – Climate Physics Research Group
Earth Science Division – Jet Propulsion Laboratory, Pasadena, CA

•Education

- Ph.D.* University of Washington (Atmospheric Sciences), September 2003-October 2008.
Advisor Dennis L. Hartmann. Dissertation Title: “Cloud Structure, Microphysics, and Precipitation in Tropical Clouds Inferred From Satellite Data.”
- B.S.* San Jose State University, August 1999-May 2003. (Major: Meteorology, Minor: Applied Mathematics). Advisor Jerry Steffens. Presidential Scholar (one in five) during term for high school scholastic excellence.

SELECTED PUBLICATIONS

- [1] **Kubar, T. L.**, G. L. Stephens, M. Lebsock, V. E. Larson, and P. A. Bogenschutz, 2015: Regional assessments of low clouds against large-scale stability in CAM5 and CAM-CLUBB using MODIS and ECMWF-Interim reanalysis data. *J. Climate*, **28**, 1685-1706.
- [2] **Kubar, T. L.** and A. Behrangi, 2015: The coupling of convection, large-scale atmospheric dynamics, and sea-surface temperature hot spots as characterized by MODIS, TRMM, CERES, and ECMWF-Interim data. To be submitted to *J. Climate*. in 12/15.
- [3] **Kubar, T. L.**, V. E. Larson, G. Stephens, R. Wood, and M. Lebsock, 2016: Synoptic to Subseasonal Vertical Correlations with MBL Cloud Top Heights over the Southeastern Pacific and Cloud Top Height/Vertical Velocity. To be submitted to *Mon. Wea. Rev.*
- [4] Terai, C. R., R. Wood, and **T. L. Kubar**, 2015: Satellite estimates of precipitation susceptibility in low-level marine stratiform clouds. *J. Geophys. Res.*, **120**, 8878-8889.
- [5] Li, J.-L.F., W.-L. Lee, T. Lee, E. Fetzer, J.-Y. Yu, **T. L. Kubar**, and C. Boening, 2015: The impacts of cloud snow radiative effects on Pacific Ocean surface heat fluxes, surface wind stress, and ocean temperatures in coupled GCM simulations. *J. Geophys. Res.*, **120**, 2242-2260.
- [6] Li, J.-L. F., W.-L. Lee, D.E. Waliser, J.-Y., Yu, X. Jiang, T. L'Ecuyer, **T. L. Kubar**, and E. Fetzer, 2015: The impacts of cloud snow radiative effects on Pacific radiative heating profile in contemporary GCMs using A-Train observations, *J. Geophys. Res.*, under revision.
- [7] Jiang, X., **T. L. Kubar**, S. Wong, W. S. Olson, and D. E. Waliser, 2014: Modulation of marine low clouds associated with the tropical intraseasonal variability over the eastern Pacific. *J. Climate*, **27**, 5560-5574.
- [8] **Kubar, T. L.**, D. E. Waliser, J.-L. Li, and X. Jiang, 2012: On the annual cycle, variability, and correlations of oceanic low-topped clouds with large-scale circulation using Aqua MODIS and ERA-Interim. *J. Climate*, **25**, 6152-6174.

- [9] Li, J.-L. F., D. E. Waliser, W.-T. Chen, B. Guan, T. L. Kubar, G. Stephens, H-Y Ma, D. Ming, L. Donner, C. Seman, and L. Horowitz, 2012: An observationally based evaluation of cloud ice water in CMIP3 and CMIP5 GCMs and contemporary reanalyses using contemporary satellite data., *J. Geophys. Res.*, **117**, D16105, doi:10.1029/2012JD017640.
- [10] Lee, J.-E., B. R. Lintner, J. D. Neelin, X. Jiang, P. Gentine, C. K. Boyce, J. B. Fisher, J. T. Perron, **T. L. Kubar**, J. Lee, and J. Worden, 2012: Reduction of tropical land region precipitation variability via transpiration. *Geophys. Res. Lett.*, **39**, L19704, doi: 10.1029/2012GL053417.
- [11] **Kubar, T. L.**, D. E. Waliser, and J.-L. Li, 2011: Boundary layer and cloud structure controls on tropical low cloud cover using A-Train satellite data and ECMWF analyses. *J. Climate*, **24**, 194-215.
- [12] D. M. Winker, J. Pelon, J. A. Coakley Jr., S. A. Ackerman, R. J. Charlson, P. R. Colarco, P. Flamant, Q. Fu, R. M. Hoff, C. Kittaka, **T. L. Kubar**, H. Le Treut, M. P. McCormick, G. Mégie, L. Poole, K. Powell, C. Trepte, M. A. Vaughan, and B. A. Wielicki, 2010: The CALIPSO Mission: A Global 3D View of Aerosols and Clouds. *Bull. Amer. Met. Soc.*, **91**, 1211-1229.
- [13] **Kubar, T. L.**, D. L. Hartmann, and Wood, R., 2009: Understanding the Importance of Microphysics and macrophysics for Warm Rain in Marine Low Clouds - Part I. Satellite Observations. *J. Atmos. Sci.*, **66**, 2953-2972.
- [14] Wood, R., **T. L. Kubar**, and D. L. Hartmann, 2009: Understanding the importance of microphysics and macrophysics for warm rain in marine low clouds. Part II: Heuristic models of rain formation. *J. Atmos. Sci.*, **66**, 2973-2990.
- [15] **Kubar, T. L.** and D. L. Hartmann, 2008: Vertical structure of tropical oceanic convective clouds and its relation to precipitation. *Geophys. Res. Lett.*, **35**, L03804, doi: 10.1029/2007GL032811.
- [16] **Kubar, T. L.**, D. L. Hartmann, and R. Wood, 2007: Radiative and convective driving of tropical high clouds. *J. Climate*, **20**, 5510-5526.
- [17] Lopez, M. A., D. L. Hartmann, P. N. Blossey, R. Wood, C. S. Bretherton, and **T. L. Kubar**, 2009: A test of the simulation of tropical convective cloudiness by a cloud-resolving model. *J. Climate*, **22**, 2834-2849.

Current Awards				
PI Name	Award/Project Title	Program Info	Period & Total Budget	Commitment (Person-Months per Year)
Terence Kubar	The Science of Aqua and Terra: “Radiative and Large-Scale Forcing of Tropical Clouds and Their Controls on High SST Environments Using Multi-Sensor Aqua and ECMWF-Reanalysis Datasets”	NASA-ROSES	11/01/2014 to 09/30/2017	10 MM/yr first year, then reduction in years two and three
Seungwon Lee (Lead JPL PI), Terence Kubar (UCLA PI)	“Climate Model Diagnostic Analyzer”	NASA-ROSES	07/01/2015 to 04/30/2017	1.2 MM/yr
Feiqin Xie	NASA Remote Sensing Theory for Earth Science (RST14) – “Advanced Retrieval of Cloudy Boundary Layer with MODIS, AMSR-E, and GPS Radio Occultation’s Direct and Reflected Measurements”	NASA-ROSES (NASA/Goddard Space Flight Center)	11/01/2015 to 07/14/2017	1.2 MM/yr

Selected Presentations at Scientific Meetings/Research Institutes/Universities

- MODIS Science Team Meeting, Silver Spring, MD (May 2015), Poster and Oral Presentations: “The Coupling of Convection, Large-Scale Atmospheric Dynamics, and Sea-Surface Temperature Hot Spots as Characterized by MODIS, TRMM, and ECMWF-Interim Reanalysis Data”*
- American Geophysical Union Joint Assembly and Fall Meeting, San Francisco, CA (December 2014), Poster Presentation: “Synoptic to Subseasonal Vertical Correlations with MBL Cloud Top Heights over the Southeastern Pacific and Cloud Top Height/Vertical Velocity Relationships in a Baroclinic Atmosphere Using Satellite and Re-Analysis Data”*
- American Geophysical Union Joint Assembly and Fall Meeting, San Francisco, CA (December 2013), Oral Presentation: “Regional Assessments of Low Clouds Against Large-Scale Forcing in CAM5 and CAM-CLUBB using MODIS and ECMWF-Interim Reanalysis Data”*
- Boundary Layer Cloud Group Meeting, JPL (February 2013): “CAM-CLUBB Results and PDF Comparisons with Satellite Data in the Southeast Pacific Cross Section along 20°S”*
- Climate Process Team Annual Meeting, NCAR at Boulder, CO (February 14-February 15, 2013), Oral Presentation: “CAMCLUBB Results and PDF Comparisons with Satellite Data in the Southeast Pacific Cross Section along 20°S”*
- American Geophysical Union Joint Assembly and Fall Meeting, San Francisco, CA (December 2012), Oral Presentation: “Synoptic Scale Variability of Low Cloud Fraction/Depth and Large-Scale Dynamics over the Southeastern Pacific 20°S Cross Section Using MODIS and ERA-Reanalysis Data”*

- *Climate Process Team Annual Meeting, NCAR at Boulder, CO (January 31-February 1, 2012), Oral Presentation:* “Satellite and Reanalysis Data Insights of VOCA and the Larger Southeastern Pacific Domain”.
- *American Geophysical Union Joint Assembly and Fall Meeting, San Francisco, CA (December 2011), Oral Presentation:* “On the Annual Cycle, Variability, and Correlations of Oceanic Low-Topped Clouds With Large-Scale Circulation using MODIS and ERA-Interim.”
- *World Climate Research Programme Open Science Conference (October 2011), Poster Presentation:* “On the Annual Cycle, Variability, and Correlations of Oceanic Low-Topped Clouds and the Large-Scale Circulation Using Aqua MODIS and ECMWF-Interim.”
- *Talk at JPL Climate Physics Group Meeting (August 2011):* “On the Annual Cycle, Variability, and Correlations of Oceanic Low-Topped Clouds With Large-Scale Circulation Using Aqua MODIS and ECMWF-Interim.”
- *Gordon Research Conference on Radiation and Climate, Colby College, Waterville, ME (July 2011), Poster Presentation:* “On the Annual Cycle, Variability, and Correlations of Oceanic Low-Topped Clouds and the Large-Scale Circulation Using AQUA MODIS and ECMWF-Interim.”
- *American Meteorological Society Annual Meeting, Seattle, WA (January 2011), Oral Presentation:* “Low Cloud and SST Annual Cycle, Variability, and Dynamics Over the Tropical and Subtropical Oceans Using Aqua MODIS and ECMWF Analysis.”
- *American Geophysical Union Joint Assembly and Fall Meeting, San Francisco, CA (December 2010), Poster Presentation:* “Low Cloud and SST Annual Cycle, Variability, and Microphysical Relationships in Primary Tropical and Subtropical Stratocumulus Regimes Using Aqua MODIS.”
- *Keck Institute for Space Studies, Innovative Satellite Observations to Characterize the Cloudy Boundary Layer, Pasadena, CA (September 2010), Poster Presentation:* “Controls on Tropical Low Cloud Cover Using A-Train Satellite Data and ECMWF Analyses”
- *Seminar at JPL Aerosol-Cloud Seminar Series, Pasadena, CA (September 2010):* “Controls on Tropical Low Cloud Cover and Cloud Heterogeneity Using A-Train Satellite Data and ECMWF Analyses”
- *JPL Postdoc Poster Day, Pasadena, CA (August 2010):* “Controls on Tropical Low Cloud Cover Using A-Train Satellite Data and ECMWF Analyses”
- *Seminars at Academia Sinica and National Taiwan University, Taipei, Taiwan (June/July 2010):* “Controls on Tropical Low Cloud Cover and Cloud Heterogeneity Using A-Train Satellite Data and ECMWF Analyses”
- *Western Pacific Geophysics Meeting, Taipei, Taiwan (June 2010), Poster Presentation:* “Boundary Layer and Cloud Structure Controls on Tropical Low Cloud Cover Using A-Train Satellite Data and ECMWF Analyses”
- *American Geophysical Union Joint Assembly and Fall Meeting, San Francisco, CA (December 2009): Poster Presentation:* “An Understanding of the Boundary Layer Cloud Frequency and Vertical Structure in the Tropical and Subtropical Pacific Using A-Train Satellite Data and ECMWF-YOTC Analyses.”
- *Yuk Lunch Seminar Series, Caltech, Pasadena, CA (November 2009):* A Better Understanding of the Boundary Layer and Cloud Structure and Dynamic and Stability Controls on Cloud Cover in the Tropics and Subtropics Using A-Train Satellite Data and ECMWF Dynamical and Cloud Fields”
- *JPL Postdoc Poster Day, Pasadena, CA (September 2009):* “An Improved Understanding of the Boundary Layer Cloud Frequency and Vertical Structure in the Tropical and Subtropical Pacific Using A-Train Satellite Data and ECMWF Analyses”
- *CALIPSO/CloudSat Science Team Meeting, Madison, WI (July 2009): Oral Presentation:* “Towards an Improved Understanding of the Boundary Layer and Vertical Cloud Structure in the Transition from the Tropical to Subtropical Pacific Cross Section.”
- *Gordon Conference on Radiation and Climate, Colby-Sawyer College, New London, NH (July 2009):* “Towards an Improved Understanding of Boundary Layer and Vertical Cloud Structure in the Transition from the Tropical to Subtropical Pacific Cross Section.”
- *American Meteorological Society Annual Meeting, Phoenix, AZ (January 2009): Oral Presentation:* “Understanding the Importance of Microphysics and Macrophysics for Warm Rain in Marine Low

Clouds Using MODIS and CloudSat”

- American Geophysical Union Joint Assembly and Fall Meeting, San Francisco, CA (December 2007): Poster Presentation: “The Vertical Structure of Tropical Oceanic Convective Clouds and its Relation to Precipitation”*

- Gordon Conference on Radiation and Climate, Colby-Sawyer College, New London, NH (July/August 2007): Poster Presentation: “Vertical Structure of Tropical Clouds and Precipitation Across the ITCZ”*

- American Geophysical Union Joint Assembly and Fall Meeting, San Francisco, CA (December 2006): Oral Presentation: “Radiative Driving of Tropical High Clouds”*

•Active Reviewer for the following Journals:

*Journal of Climate; Monthly Weather Review; Weather Climate and Society; Journal of the Atmospheric Sciences; Journal of Hydrometeorology; Journal of Applied Meteorology and Climatology; Weather and Forecasting; Journal of Geophysical Research; Geophysical Research Letters; International Journal of Climatology; Journal of the Meteorological Society of Japan; Journal of Advances in Modeling Earth Systems; Atmosphere; **Dynamics of Oceans and Atmospheres.***

•Public Seminars/Talks

- Presentation to JPL in-house Green Club (June 2012): “Scientific Controversies, Past and Present”*

- Talk at JPL to Student Interns (1 April 2011): “Cloudy Skies, Feedbacks, and Climate”*

- JPL Climate Day 2010 – Bringing scientists, students, and communities together to promote climate literacy, Pasadena, CA (March 2010): “Cloudy Skies and Climate Change”*

- Centers for Ocean Sciences Education Excellence Talk at JPL, Pasadena, CA (February 2010): “Cloud Structure, Composition, and Feedbacks in the Current Climate and a Warming World”*

- Centers for Ocean Sciences Education Excellence Talk at Natural History Museum, University of Southern California, Los Angeles, CA (February 2010): “Cloud Structure, Composition, and Feedbacks in the Current Climate and a Warming World”*

- Public Talk at Neighborhood Church, Pasadena, CA (September 2009): “Removing the Mystery of Predicting Climate Change”*

•Professional Society Membership

- American Meteorological Society

- American Geophysical Union

•Honors/Awards

- (2015): Was invited and served on the proposal review panel of approximately 20 members for the Atmospheric System Research Program within the Department of Energy’s Office of Science for the **Convective Processes Panel** near Washington, D.C. in Rockville, MD.

- (2014): Selected Award for NASA ROSES as **Principal Investigator** of the Science of Terra and Aqua, entitled: “Radiative and Large-Scale Forcing of Tropical Clouds and Their Controls

on High SST Environments Using Multi-Sensor Aqua and ECMWF-Reanalysis Datasets”, with funding for three years

- (2010-2011): Caltech Postdoctoral Scholar,
- (2008-2010): NASA Postdoctoral Program Fellowship Award Recipient
- (2005): University of Washington Department of Atmospheric Sciences forecasting competition champion
- (2003): Graduate School Top Scholar Award recipient
- (1999-2003): President’s Scholar (five awards per year), San Jose State University
- (2001-2003): Golden Key International Honour Society Member
- (2001-2003): Dean’s Scholar, San Jose State University

•Computational Skills

- Languages*: IDL (**12 years of experience**), FORTRAN, C, Matlab
- Operating Systems*: Unix/Linux, Windows